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(56) Documents Cited
GB 2232536 A GB 2219471 A GB 1321968 A
GB 1071171 A GB 0627751 A EP 0568507 A1

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(71) Applicant(s)
Northern Telecom Limited

(Incorporated in Canada - Quebec)

World Trade Center of Montreal,
380 St Antoine Street West,8th Floor, Montreal,
Quebec H2Y 3Y4, Canada

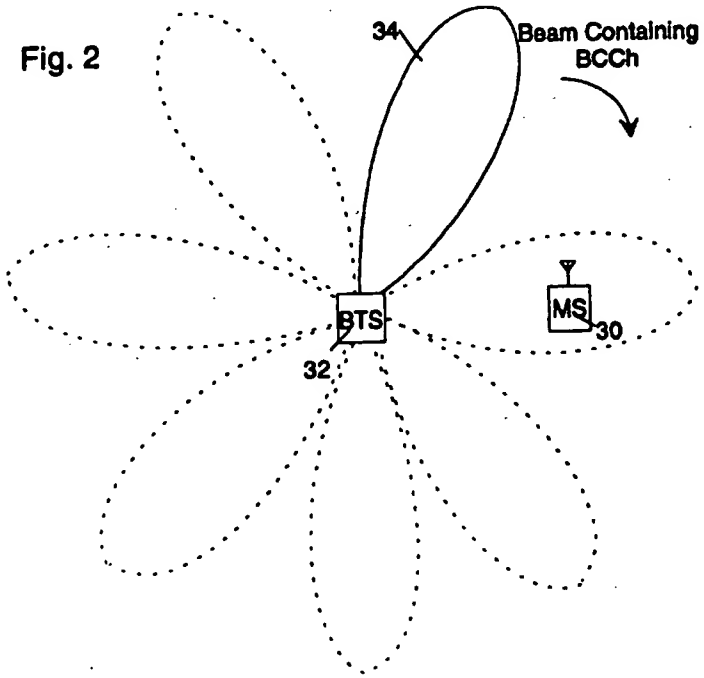
(72) Inventor(s)
Jeffrey Graham Searle

(74) Agent and/or Address for Service
E Humphrey-Evans
Northern Telecom Europe Limited, Patents and Licensing, West Road, HARLOW, Essex, CM20 2SH, United Kingdom

(54) Beamed antenna system for a cellular radio base station

(57) In order to overcome the high power requirements of an omni-directional antenna for a broadcast control channel (BCCH) at a base station 32, an antenna arrangement (20, Fig. 1) provides a plurality of narrow beams 34 connected via an n-way switch (18) to the BCCH transceiver (14) at the base station 32, so that the area of coverage of the BCCH sweeps around the cell during a given period of time. The dwell time for the BCCH in each beam may be based on the time slot framework so that the BCCH is not switched between beams in mid time slot. Signal strength measurements may be conducted on burst type signals appearing at random intervals of time, whereby a maximum period between bursts can be determined.

Fig. 2



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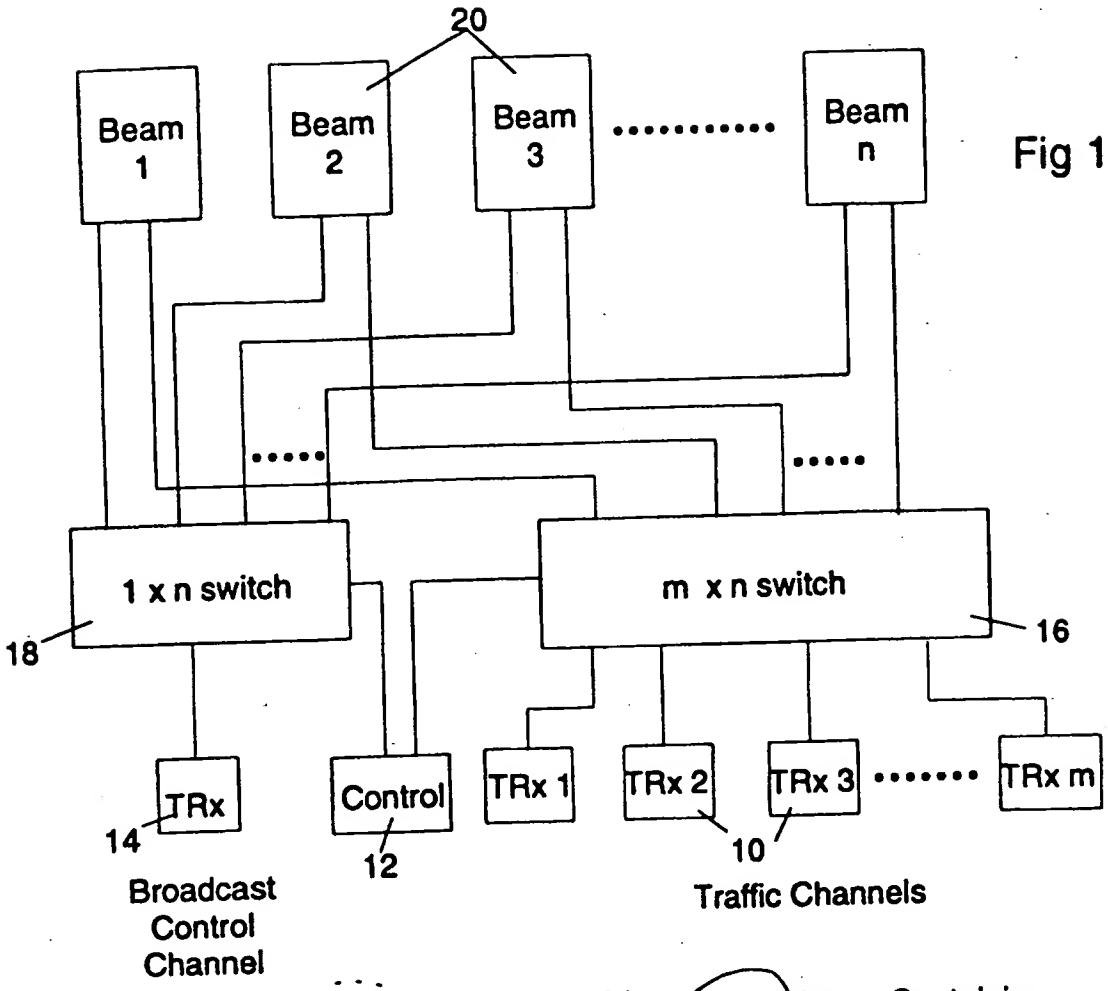
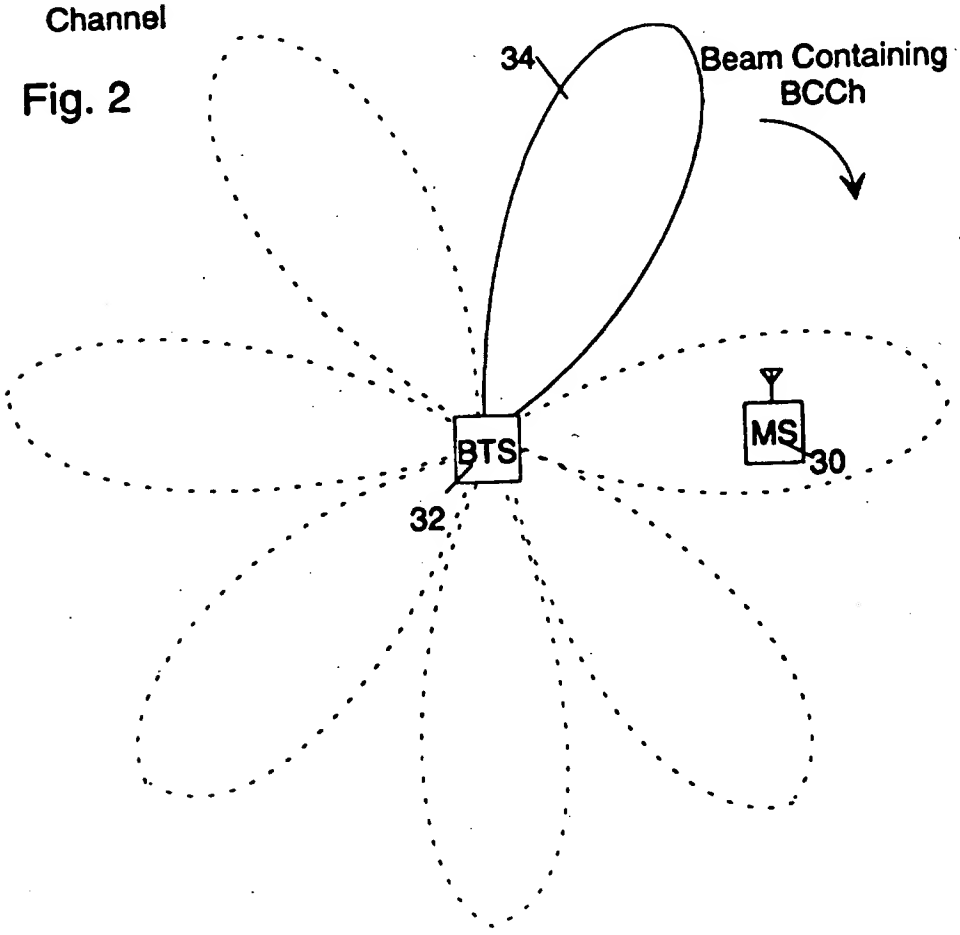

20
Beam 1
Beam 2
Beam 3
Beam n
1 x n switch
m x n switch
18
16
TRx
14
Control
12
TRx 1
TRx 2
TRx 3
TRx m
10
Broadcast Control Channel
Traffic Channels

Fig 1

Fig. 2


34
Beam Containing BCCh
BTS
32
MS
30

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A BEAMED ANTENNA SYSTEM

This invention relates to a beamed antenna system and in particular relates to the operation of a broadcast control channel as used in cellular radio communications systems so as to provide omni-coverage characteristics.

Cellular radio systems are currently in widespread use throughout the world providing telecommunications to mobile radio users. In order to meet the capacity demand, within the available frequency band allocation, cellular radio systems divide a geographic area to be covered into cells. At the centre of each cell is a base station through which the mobile stations communicate. Each cell has a single broadcast control channel that is assigned to a single frequency and is transmitted from the base station. The base stations use the broadcast channel to identify themselves as a base station, either as the primary station in the area or, as an additional station to the one currently in use. Each mobile station will take signal strength measurements from all the broadcast channels it can receive. This information will be employed so that an optimum signal strength is received at all times and this data is employed for use in handover algorithms, on change of base station. This ensures that the mobile station is always connected to the most appropriate base station. It is from the broadcast channel that a mobile station learns which frequency to use to contact the base station and when the base station has an incoming call for the mobile station.

Accordingly the broadcast channel is a fundamental element in a cellular radio system. The use of cellular radio systems is governed by GSM recommendations which require each broadcast channel to be transmitted continuously over the entirety of the cell.

Such a constriction is very demanding for the rapidly emerging systems that utilise the concept of multiple narrow beams for the conveyance of traffic channels. These systems with their high gain narrow beams can give greater range coverage without requiring larger sized power amplifiers. A narrow beam system can produce a nominally omni-directional broadcast channel in one of two ways: All of its beams can be transmitted simultaneously but this results in phase problems - not only with the base station but also with neighbouring base stations. An additional omni directional antenna can be used but the disadvantage of the omni antenna is that it has a significantly lower gain than a narrow beam antenna, and thus to cover the same range as the traffic channels the omni antenna requires a significantly higher power amplifier.

The ratio gains of antennae of different beam widths is approximately equal to the ratio of these beam widths, with the narrower beam having the higher gain. Consider the following example of a narrow beam system using 10% beamwidth traffic antenna:

$$\frac{G_{beam}}{G_{omni}} \approx \frac{360}{10} = 36 = 15.6dB$$

Therefore as the gain of the narrow beam antenna is approximately 36 times greater than the gain of the omni antenna, the power amplifier in the omni path would need to be 36 times the power of the one in the traffic path, in order to cover the same range. Thus for a 25 watt traffic amplifier a 900 watt omni amplifier would be required.

The present invention seeks to overcome the problem associated with omni directional antenna.

According to the present invention there is provided a base station antenna arrangement capable of forming a plurality of beams, with selection means capable of assigning a single channel via one or more of these beams, such that its area of coverage sweeps around the cell during a given period of time. The area of coverage can be around the whole or part of the cell. Preferably there is also provided means at the mobile station to isolate control information. Preferably signal strength

measurements are conducted on burst type signals appearing at random intervals of time whereby a maximum period between bursts can be determined.

In accordance with another aspect of the invention there is provided a method of operating a base station antenna arrangement wherein the broadcast signal is provided in a narrow beam and which narrow beam sweeps around the whole or part of a cell during a given period of time.

Reference will now be made to the Figures of the accompanying drawings sheets wherein:

Figure 1 shows a first embodiment of the invention; and

Figure 2 shows a base transmitter station transmitting an omni coverage beam.

Referring now to Figure 1, the traffic transceivers 10 1...m are connected via a multi- way switch 16 to each of the beams 18 such that each traffic transceiver 10 can be connected to any beam. The broadcast control channel transceiver 14 is connected to an n-way switch 18 where n defines the number of beams in the system. The outputs from the switch are connected one to each beam 20. Depending upon the amplification arrangements, the beams will be either capable of transmitting at least one traffic channel as well as the control channel or the control channel can only be transmitted in a beam that does not have any traffic in that time slot.

The dwell time for the broadcast channel in each beam will depend on the type of messages to be transmitted, but ideally would be based on the time slot framework such that the control channel is not switching in mid time slot.

The mobile 30 as depicted in Figure 2 will only receive the broadcast channel for a proportion of the time, when the mobile is in the beam 34 selected by the base station 32 to broadcast the control channel. The time interval between receiving a broadcast control channel and the next one will vary as the mobile station moves between beams. The mobile station also has to contend with the scenario of receiving two consecutive

broadcasts, assuming that the base station moves from one beam to its immediate neighbour.

The key advantage of this invention lies in its ability to provide a control channel to the whole cell simultaneously with traffic transmissions through the same antenna aperture. As current methods require either a separate omni antenna with a high power amplifier or the ability to simultaneously transmit all beams, this method offers simplicity of equipment with lower power consumption.

CLAIMS

1. A base station antenna arrangement capable of forming a plurality of beams, having selection means capable of assigning a single channel via one or more of these beams such that its area of coverage sweeps around the cell during a given period of time.

2. An arrangement according to claim 1 wherein decoding means are provided at the mobile station to isolate control information.

3. An arrangement according to claim 2 wherein signal strength measurements are conducted on burst type signals appearing at random intervals of time whereby a maximum period between bursts can be determined.

4. A base station antenna arrangement according to any one of of claims 1 to 3 wherein the area of coverage of the single channel during a given period of time is the whole of the cell.

5. A base station antenna arrangement substantially as described herein with reference to any one or more of the figures as shown in the accompanying drawing sheets.

6. A method of operating a base station antenna arrangement wherein the broadcast signal is provided in a narrow beam and which narrow beam sweeps around the whole or part of a cell during a given period of time.

7. A method substantially as described herein with reference to any one or more of the Figures as shown in the accompanying drawing sheets.

Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search report)

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Relevant Technical Fields

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Search Examiner
MR M J BILLING

Date of completion of Search
7 FEBRUARY 1995

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE DATABASES WPI

Documents considered relevant following a search in respect of Claims :-
1, 2, 4, 6

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2232536 A	(MITSUBISHI) Figures 1-5; Abstract. page 1 lines 3-7	1, 4, 6 at least
X	GB 2219471 A	(COSSOR) Figures 1-3; Abstract	1, 4, 6 at least
X	GB 1321968	(THOMSON-CSF) Figures 1, 2; page 1 lines 9-70	1, 4, 6 at least
X	GB 1071171	(STC) Figure 7; page 6 line 69 to page 7 line 35	1, 6 at least
X	GB 627751	(MARCONI) Figure 1; page 2 lines 38-83	1, 4, 6 at least
X	EP 0568507 A1	(TELEVERKET) Figures 1-4; column 3 lines 17-52	1, 2, 4, 6 at least

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).